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(54) ACTIVE MATRIX TYPE LIQUID CRYSTAL DISPLAY DEVICE

(57)Abstract:
PURPOSE: To obtain a liquid crystal display device which does not require a transparent electrode by forming a signal electrode, a picture element electrode and a shield electrode existing between the signal electrode and the picture element electrode and capable of always applying potential from the outside on a picture element part.
CONSTITUTION: The stripe-form pixel electrode 3, a common electrode 4, the signal electrode 2 and the shield electrode 5 existing between the signal electrode and the picture element electrode and always applying the potential from the outside are formed on the inner sides of a pair of transparent base plates 8 and 9 of the pixel part. Then, orientation control films 14 and 15 (orientation direction 28) are formed thereon and liquid crystal composition is held between the films 14 and 15. By applying electric field E on the electrodes 5, 3 and 4, the direction of liquid crystal molecules is changed to the direction of the electric field E. When polarizing plates 26 and 27 are arranged so

that their polarized light transmission axes 29 may form a specified angle, light transmissivity is varied by applying the electric field. Therefore, such constitution makes display with contrast possible without the transparent electrode.

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CLAIMS

[Claim(s)]
[Claim 1] A liquid crystal constituent is pinched between the 1st and 2nd substrate. To the 1st substrate In the active matrix liquid crystal display with which two or more picture element parts are constituted with two or more scan electrodes and signal electrodes which have been arranged in the shape of a matrix, and the switching transistor component is prepared in said picture element part A pixel electrode is connected, and said switching transistor component is constituted so that it can operate keeping the direction of a major axis of a liquid crystal molecule almost parallel to a substrate side with the common electrode countered and formed in said pixel electrode and this. The active matrix liquid crystal display characterized by forming the screening

electrode which is in said picture element part a signal electrode, a pixel electrode and a signal electrode, and pixel inter-electrode, and can always give potential from the exterior.
[Claim 2] The active matrix liquid crystal display according to claim 1 with which said screening electrode is formed on the light transmission section between a signal electrode and a pixel electrode, the light transmission section between a signal electrode and a common electrode, and the semi-conductor barrier layer of a switching transistor component.
[Claim 3] The active matrix liquid crystal display according to claim 1 with which the black or the light-shielding film of low light transmittance which contains a pigment or a color in the light transmission section which the line of electric force from the light transmission section [between the signal electrode of said picture element part and a pixel electrode], light transmission section [between a signal electrode and a common electrode], and semi-conductor barrier layer top of a switching transistor component and a scan electrode passes is formed.
[Claim 4] A liquid crystal constituent is pinched between the 1st and 2nd substrate. To the 1st substrate In the active matrix liquid crystal display with which two or more picture element parts are constituted with two or more scan electrodes and signal electrodes which have been arranged in the shape of a matrix, and the switching transistor component is prepared in said picture element part As for said switching transistor component, a pixel electrode is connected. To said picture element part Are in a signal electrode and a signal electrode, and pixel inter-electrode, and the screening electrode which can always give potential from the exterior is formed. Said screening electrode and pixel electrode are an active matrix liquid crystal display characterized by being constituted so that it can operate being formed face to face and keeping the direction of a major axis of a liquid crystal molecule almost parallel to a substrate side by said two electrodes.
[Claim 5] The active matrix liquid crystal display according to claim 4 currently formed so that said some of screening electrodes may lap with a signal electrode.
[Claim 6] The active matrix liquid crystal display according to claim 4 or 5 with which the black or the light-shielding film of low light transmittance which contains a pigment or a color in the light transmission section which the line of electric force from the light transmission section [between the signal electrodes and screening electrodes of said picture element part] and semi-conductor barrier layer top of said switching transistor component and a scan electrode passes is formed.
[Claim 7] The active matrix liquid crystal display according to claim 1 to 6 with which said screening electrode is formed in said 1st substrate.
[Claim 8] Said screening electrode is claims 1-4 currently formed in the same layer as a signal electrode, and an active matrix liquid crystal display given in 6 or 7.
[Claim 9] Said screening electrode is an active matrix liquid crystal display according to

claim 1 to 7 currently formed in the same layer as a scan electrode.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Industrial Application] This invention relates to an active matrix liquid crystal display.

[0002]

[Description of the Prior Art] The transparent electrode which was made to carry out phase opposite and was formed on the two substrates interface as an electrode which drives a liquid crystal layer was used for the conventional active matrix liquid crystal display. This is because the Twisted Nematic means of displaying which operates by making into a direction almost perpendicular to a substrate interface the direction of the electric field impressed to liquid crystal is adopted.

[0003] The active matrix liquid crystal display using the method which, on the other hand, makes the direction of the electric field impressed to liquid crystal a direction almost parallel to a substrate interface is proposed by JP,56-91277,A.

[0004]

[Problem(s) to be Solved by the Invention] The conventional technique using the aforementioned Twisted Nematic means of displaying must form the transparent electrode represented by Indium TinOxide (ITO). However, a transparent electrode has the irregularity of about several 10nm in the front face, and makes difficult processing of a detailed active component like a thin film transistor (henceforth TFT). Furthermore, the heights of a transparent electrode were reducing the yield of a product remarkably in order to often break away, to mix in other parts, such as an electrode, and to cause a punctiform or linear display defect.

[0005] Moreover, in said conventional technique, it had many technical problems also in respect of image quality. The brightness change at the time of changing the viewing-angle direction especially was remarkable, and indicated it difficult by halftone.

[0006] Furthermore, the scan electrode and signal electrode for driving a switching transistor component in addition to the pixel electrode which impresses an electrical potential difference or electric field to liquid crystal, and modulates the transmitted light or the reflected light in the active-matrix mold display device using a switching transistor component again are required. This scan electrode and signal electrode fluctuate the potential of a pixel electrode with the scan electrode-pixel inter-electrode parasitic capacitance Cgs and the signal-electrode-pixel inter-electrode parasitic capacitance Cds. Since especially the potential of a signal electrode is continuously changed using image information, with the signal-electrode-pixel inter-electrode

parasitic capacitance Cds, the potential of a pixel electrode is changed and it is generating the poor image quality called a fall or cross talk of contrast.

[0007] By the method which makes the direction of the electric field impressed to liquid crystal a direction almost parallel to a substrate interface, as compared with the case of the Twisted Nematic means of displaying, the signal-electrode-pixel inter-electrode parasitic capacitance Cds became large, and there was a problem that a cross talk was intense and contrast fell with an image pattern. Because, since the common electrode is not constituted from a method which makes almost parallel to a substrate interface the direction of electric field impressed to liquid crystal all over the substrate which has a switching transistor component, and the substrate which counters unlike the Twisted Nematic means of displaying, it is for not shielding the line of electric force from a signal electrode, but carrying out termination to a pixel electrode. For this reason, by the method which makes the direction of electric field almost parallel to a substrate interface, the active-matrix drive had a problem in the image quality side.

[0008] The first purpose of this invention is to offer the active matrix liquid crystal display which does not need a transparent electrode.

[0009] The second purpose of this invention has a good viewing-angle property, and it is to offer an active matrix liquid crystal display with an easy multi-tone display.

[0010] The third purpose of this invention is to offer the high-definition active matrix liquid crystal display which a cross talk does not produce by high contrast.

[0011]

[Means for Solving the Problem] The summary of this invention which attains said purpose is as follows.

[0012] A liquid crystal constituent is pinched between the 1st and 2nd substrate. (1) To the 1st substrate In the active matrix liquid crystal display with which two or more picture element parts are constituted with two or more scan electrodes and signal electrodes which have been arranged in the shape of a matrix, and the switching transistor component is prepared in said picture element part A pixel electrode is connected, and said switching transistor component is constituted so that it can operate keeping the direction of a major axis of a liquid crystal molecule almost parallel to a substrate side with the common electrode countered and formed in said pixel electrode and this. It is shown in the active matrix liquid crystal display with which the screening electrode which is in said picture element part a signal electrode, a pixel electrode and a signal electrode, and pixel inter-electrode, and can always give potential from the exterior is formed.

[0013] (2) Said screening electrode is formed in the light transmission section except the light transmission section between a pixel electrode and a common electrode.

[0014] (3) The black or the light-shielding film of low light transmittance in which the light transmission section except the light transmission section between the pixel electrode of said picture element part and a common electrode contains a pigment or a

color is formed.

[0015] (4) A pixel electrode is connected to said switching transistor component, it is in said picture element part a signal electrode and a signal electrode, and pixel inter-electrode, and the screening electrode which can always give potential from the exterior is formed, and said screening electrode and pixel electrode counter, are formed, and they are constituted so that it may operate, while the direction of a major axis of the liquid crystal molecule of a liquid crystal constituent layer keeps it almost parallel to a substrate side by said two electrodes.

[0016] (5) It is formed so that said some of screening electrodes may lap with a signal electrode.

[0017] (6) The black or the light-shielding film of low light transmittance which contains a pigment or a color in the light transmission section except the light transmission section between the pixel electrodes and screening electrodes of said picture element part is formed.

[0018] (7) Said screening electrode is formed in said 1st substrate.

[0019] (8) Said screening electrode is formed in the same layer as a signal electrode.

[0020] (9) Said screening electrode is formed in the same layer as a scan electrode.

[0021]

[Function] Next, an operation of this invention is explained using drawing 1 .

[0022] Drawing 1 (c) and (d of drawing 1 (a) and (b)) are the top view about the 1-pixel side cross section within the liquid crystal cell of this invention. The active component is omitted in drawing 1 . Moreover, although the scan electrode and the signal electrode were formed in the shape of a matrix and two or more pixels were constituted from this invention, the 1-pixel part was shown here.

[0023] The cel sectional side elevation at the time of no electrical-potential-difference impressing is shown in drawing 1 (a), and the top view at that time is shown in drawing 1 (c). The stripe-like pixel electrode 3, the common electrode 4, a signal electrode 2, and a screening electrode 5 are formed inside the substrates 8 and 9 of a transparent pair, the orientation control film 14 and 15 (the direction 28 of orientation) is formed on it, and the liquid crystal constituent is pinched in the meantime.

[0024] At the time of no electric-field impressing, orientation of the rod-like liquid crystal molecule 25 is carried out so that it may become some include angle, i.e., the angle |<90 degree which the direction of a liquid crystal molecule major axis (optical axis) near the interface to the direction of 45 degree <=| electric field makes, to the longitudinal direction of a stripe-like electrode. In addition, the case where the direction of orientation in the vertical interface of a liquid crystal molecule is parallel is explained to an example here. Moreover, the dielectric anisotropy of a liquid crystal constituent is made forward.

[0025] Next, if electric field E are impressed to the pixel electrode 3 and the common electrode 4, as shown in drawing 1 (b) and (d), a liquid crystal molecule will change the

sense in the direction of electric field E. It becomes possible by arranging the polarization transparency shaft 29 of polarizing plates 26 and 27 so that it may become a predetermined include angle to change light transmittance by electric-field impression.

[0026] Thus, even if there is no transparent electrode according to this invention, the display with contrast is attained. As a concrete configuration which gives contrast The mode using a condition with the almost parallel liquid crystal molecular orientation on a vertical substrate (since the interference color by birefringence phase contrast is used) here -- birefringence mode -- calling -- there is the mode (since the optical activity which plane of polarization rotates within a liquid crystal constituent layer is used, it is called optical-activity mode here) with which the direction of liquid crystal molecular orientation on a vertical substrate crossed, and the molecular arrangement within a cel used the distorted condition.

[0027] In birefringence mode, the direction of a molecule major axis (optical axis) changes the bearing into a substrate interface in a field to parallel raw mostly by electrical-potential-difference impression, the angle with the shaft (an absorption shaft or transparency shaft) of the polarizing plates 26 and 27 set as the predetermined include angle to make changes, and light transmittance is changed. Although optical-activity mode changes bearing of the direction of a molecule major axis by electrical-potential-difference impression similarly, change of the optical activity by a spiral coming loose in this case is used.

[0028] In this display mode which makes almost parallel to a substrate interface the direction of the electric field impressed to liquid crystal, the major axis of a liquid crystal molecule is always almost parallel to a substrate, and does not start. Therefore, even if it changes the viewing-angle direction, change of brightness is small (there is no viewing-angle dependency), and the so-called viewing-angle property is excellent.

[0029] A dark condition is not acquired because this display mode makes birefringence phase contrast zero mostly by electrical-potential-difference impression like before, a dark condition is acquired by changing the angle of a liquid crystal molecule major axis and the shaft (an absorption shaft or transparency shaft) of a polarizing plate to make, and the operations differ fundamentally. In the case where a liquid crystal molecule major axis is made to start at right angles to a substrate interface like the conventional TN mold, the viewing-angle direction where birefringence phase contrast serves as zero is a direction perpendicular to a transverse plane, i.e., a substrate interface, and if it inclines even when viewing angles are few, birefringence phase contrast will appear. Therefore, in a NOMARI open type, light causes the fall of leakage and contrast, and reversal of gradation level.

[0030] Next, another important operation of the liquid crystal display of this invention is shown. if the pixel electrode 3 adjoins a signal electrode 2 and is constituted -- the line of electric force from a signal electrode 2 -- the pixel electrode 3 -- termination -- carrying out -- a degree -- a type -- **** -- the parasitic capacitance Cds between the

signal-electrode 2-pixel electrodes 3 which are expressed occurs.
[0031]
[Equation 1]

$$Cds = \frac{2\varepsilon}{\pi} \ln(1 + \frac{W}{d}) \qquad \cdots [1]$$

[0032] In the width of face (short hand lay length) of the pixel electrode 3, and d, the distance of a signal electrode 2 and the pixel electrode 3 and epsilon express the dielectric constant of an inter-electrode medium, as for W, pi expresses a circular constant, and parasitic capacitance Cds shows the capacity per unit length.
[0033] In addition, in the above, the dielectric constant of an inter-electrode medium is fixed, and the width of face of a signal electrode 2 assumes that it is equal to the width of face of the pixel electrode 3, or is more than it.
[0034] In the liquid crystal display of this invention, since the screening electrode 5 was formed between the signal electrode 2 and the pixel electrode 3, most line of electric force from a signal electrode 2 carries out termination to a screening electrode 5. If potential is always given from the exterior so that the potential of a screening electrode 5 may become fixed, the parasitic capacitance Cds between the signal-electrode 2-pixel electrodes 3 will decrease sharply. Since the potential of the pixel electrode 3 does not change by this even if the potential of a signal electrode 2 changes, a cross talk is lost. Thereby, this display mode is applicable to a active matrix, and a viewing-angle property is good and can obtain high contrast and a high-definition liquid crystal display.
[0035] Moreover, since a screening electrode 5 can also be made to serve a double purpose as a protection-from-light layer (black matrix), the manufacture yield can be improved together with the point which there is no need for formation of a protection-from-light layer, and does not need a transparent electrode.
[0036] Furthermore, a screening electrode can be made to serve as a common electrode, and since a screening electrode can use the area which the common electrode occupied, its numerical aperture can improve, and it can be made into high brightness or a low power again.
[0037]
[Example] An example explains this invention concretely. in addition -- the following examples -- the display-panel side of a liquid crystal display -- setting -- the longitudinal direction of a signal electrode -- parallel (perpendicular to the longitudinal direction of a scan electrode) -- a direction -- a perpendicular direction and the longitudinal direction of a signal electrode -- a perpendicular (parallel to the longitudinal direction of a scan electrode) -- making a direction horizontal, said perpendicular direction, and parallel and a line writing direction make the direction of a train of a matrix electrode a direction parallel to said horizontal direction. Moreover, the number of pixels was set to 640 (x3)x480, as a pitch of each pixel, the longitudinal direction was set to 110 micrometers

and the lengthwise direction was set to 330 micrometers.

[0038] [Example 1] The ** type top view of the picture element part of the liquid crystal display panel of this example is shown in drawing 2 (a), and the type section Fig. of A-A' of drawing 2 (a) is shown in drawing 2 (b). Moreover, the drive structure-of-a-system Fig. of the liquid crystal display of this example is shown in drawing 3 . In addition, the glass substrate with a thickness of 1.1mm which ground the front face as substrates 8 and 9 was used.

[0039] On the substrate 8, the scan electrodes 1 and 17 of Cr were formed horizontally. Moreover, it was made to intersect perpendicularly with the scan electrodes 1 and 17, and the signal electrodes 2 and 18 of Cr/aluminum were formed. Furthermore, an amorphous silicon 6, some scan electrodes 1 (it works as a gate electrode), some signal electrodes 2 (it works as a drain electrode or a source electrode), and the thin film transistor (TFT) component that used the pixel electrode 3 (it works as a source electrode or a drain electrode) were formed in the pixel. The silicon nitride film was used for the gate dielectric film 10 of a TFT component.

[0040] The pixel electrode 3 is the same process with the same ingredient as signal electrodes 2 and 18 at this layer, and it was formed so that a longitudinal direction might become perpendicularly. Moreover, between the signal electrode 2 and the pixel electrode 3, and the amorphous silicon 6, n+ mold amorphous silicon 7 for taking ohmic contact was formed.

[0041] The common electrode 4 was the same process at this layer with the same ingredient as the pixel electrode 3 and signal electrodes 2 and 18, it was formed in the shape of a stripe, was pulled out perpendicularly, and made common connection with the common electrode of other trains.

[0042] The orientation of the liquid crystal molecule of a liquid crystal layer is controlled by the electric field E mainly impressed to the horizontal direction between the pixel electrode 3 and the common electrode 4. Light penetrates between the pixel electrode 3 and the common electrodes 4, and incidence of it is carried out to the liquid crystal layer 16, and it is modulated. Therefore, especially the pixel electrode 3 does not need to be translucency (for example, transparent electrodes, such as ITO).

[0043] On the TFT component, the protective coat 11 of the silicon nitride which protects it was formed. Moreover, the screening electrode 5 was formed at the substrate 8 (henceforth a TFT substrate) which prepared the TFT elements on the substrate 9 (an opposite substrate is called hereafter) which carries out phase opposite. At this time, the screening electrode 5 was formed so that it might be arranged in the shape of a stripe between a signal electrode 2 and the pixel electrode 3, it was pulled out perpendicularly, and made common connection with the screening electrode of other trains.

[0044] Furthermore, on the opposite substrate 9, the color filter 12 of three colors which consist of stripe-like R, G, and B was formed perpendicularly. On the color filter 12, the laminating of the flattening film 13 which consists of transparence resin which carries

out flattening of the front face was carried out. the ingredient of the flattening film 13 -- carrying out -- the epoxy resin was used. Furthermore, the orientation control film 14 and 15 of a polyimide system was applied and formed on this flattening film 13 and a protective coat 11.

[0045] Between the above-mentioned substrate 8 and 9, dielectric constant anisotropy deltaepsilon is [the value] 7.3 in forward, and birefringence deltan sandwiched the nematic liquid crystal constituent 16 of 0.073 (589nm, 20 degrees C). In addition, in this example, although dielectric constant anisotropy deltaepsilon used forward liquid crystal, negative liquid crystal may be used.

[0046] Rubbing processing of the above-mentioned orientation control film 14 and 15 was carried out, and the pre tilt angle was made into 1.0 degrees. The direction of rubbing of a vertical interface was almost parallel mutually, and made 85 degrees the include angle with the impression electric field E to make. Moreover, the gap (d) of a vertical substrate distributed and pinched the globular form polymer bead between substrates, and set it to 4.5 micrometers in the state of liquid crystal enclosure. Thereby, deltan-d is 0.329 micrometers.

[0047] The above-mentioned panel was inserted with two polarizing plates [Gby NITTO DENKO CORP.1220DU] (a polarizing plate is an illustration abbreviation), the polarization transparency shaft of one polarizing plate was mostly considered as parallel (85 degrees) in the direction of rubbing, and another side was considered as the rectangular cross (-5 times) at it. This obtained the liquid crystal display of the Nor Malik Lowe's property.

[0048] Next, the vertical-scanning circuit 19 and the video-signal drive circuit 20 were connected on the TFT substrate 8 of the liquid crystal display panel 22 as shown in drawing 3 , from the power source and the control circuit 21, the scan signal-level, video-signal electrical-potential-difference, timing signal, common electrode voltage, and screening-electrode electrical potential difference was supplied, and the active-matrix drive was carried out.

[0049] Moreover, in this example, a screening-electrode electrical potential difference and common electrode voltage were made independent, using the silver paste, it connected with the screening electrode on a counterelectrode electrically, and the screening-electrode electrical potential difference was supplied from the TFT substrate 8.

[0050] In addition, in this example, although the amorphous silicon TFT component is used, a poly-Si TFT component is sufficient. In the case of a reflective mold indicating equipment, the MOS transistor formed on the silicon wafer is sufficient. A wiring material is not limited, either.

[0051] Moreover, in this example, although the orientation control film was prepared, direct rubbing of the front face of the flattening film 13 may be carried out, and you may serve as the orientation control film. Similarly, rubbing processing can also be

carried out, using an epoxy resin as a protective coat 11 of TFT.

[0052] Next, the applied voltage to the liquid crystal of this example and the relation of brightness are shown in drawing 4 . The contrast ratio became 150 or more at the time of 7V drive, the difference of right and left and the curve at the time of changing up and down of a viewing angle was very small compared with the conventional method (example 1 of a comparison), and even if it changed the viewing angle, a display property hardly changed. Moreover, the stacking tendency of liquid crystal was also good and the domain based on poor orientation etc. was not generated.

[0053] Change of the signal-level Vsig-brightness curve by the wave-like difference in the signal-electrode electrical potential difference Vd in this example is shown in drawing 5 . In addition, drawing 5 (a) shows a voltage waveform and drawing 5 (b) shows change of a signal-level Vsig-brightness curve.

[0054] Although the signal-electrode electrical potential difference Vd was changed after the scan electrode voltage Vg was set to on-level and the signal level Vsig was written in, a conspicuous change did not occur especially in a signal-level Vsig-brightness curve.

[0055] As mentioned above, in this example, without using a transparent electrode, the reinforcement of the transmitted light was able to be modulated and the viewing-angle dependency was able to be raised remarkably. Furthermore, the cross talk of the perpendicular direction which is the weak spot of a method where electric field are impressed to a substrate interface and parallel could be stopped, it is a high throughput and a high yield, and the liquid crystal display high-definition by the extensive viewing angle and high contrast was able to be obtained.

[0056] [Example 1 of a comparison] The Twisted Nematic (TN) mold display of the conventional method which has a transparent electrode was produced, and it compared with this and said example 1. As a liquid crystal constituent, dielectric anisotropy deltaepsilon used in the example 1 made 7.3 micrometers and a twist angle 90 degrees for the gap (d) using the forward nematic liquid crystal constituent. Therefore, deltan-d is 0.526 micrometers.

[0057] An electro-optics property is shown in drawing 6 . The curve changed with viewing-angle directions remarkably, and the domain based on the poor orientation of liquid crystal was generated near ****** of the TFT contiguity section.

[0058] [Example 2 of a comparison] Change of the signal-level-brightness property accompanying change of the signal-electrode electrical potential difference when not forming the screening electrode 5 of drawing 2 in drawing 7 is shown. The wave-like difference in the signal-electrode electrical potential difference Vd showed that a big difference arose on a signal-level Vsig-brightness curve.

[0059] Moreover, the fall of contrast was remarkable, as a vertical cross talk occurred in image quality and it was further shown in the curve of Vd' in drawing.

[0060] [Example 2] The configuration of this example is the same as that of an example

1, if the following requirements are removed.

[0061] A type section Fig. [in / for the ** type top view of the pixel of the liquid crystal display panel of this example / B-B' of drawing 8 (a)] is shown in drawing 8 (a) again at drawing 8 (b). The description on the configuration of this example is in the point in which wrap screening-electrode 5a was formed, in all the light transmission parts between the pixel electrode 3 and a signal electrode 2 and between the common electrode 4 and a signal electrode 18. By this, even if it did not prepare a protection-from-light layer, optical leakage did not arise, but high contrast was able to be acquired.

[0062] Furthermore, since the amorphous silicon 6 top was also covered, there is also no increment in the leakage current by the light of an amorphous silicon, and the good display property was able to be acquired.

[0063] Moreover, slit-like opening was prepared in the signal electrode 2 of screening-electrode 5a, and the part on 18, and the lap with signal electrodes 2 and 18 was made into the minimum so that it might become only the lap for a margin of doubling precision, so that the capacity between signal-electrode-screening electrodes might not increase as much as possible.

[0064] As mentioned above, in this example, effectiveness equivalent to an example 1 was acquired and high contrast and a high-definition active matrix liquid crystal display were able to be obtained further.

[0065] [Example 3] The configuration of this example is the same as that of an example 1, if the following requirements are removed.

[0066] drawing 9 -- (-- a --) -- this example -- a liquid crystal display -- a panel -- a pixel -- ** -- a type -- a top view -- moreover -- < -- A HREF -- = -- " -- /-- Tokujitu/tjitemdrw . -- ipdl?N -- 0000 -- = -- 239 -- & -- N -- 0500 -- = -- one -- E_N -- /--; -- > -- ? -- < -- = -- : -- 69 -- > -- /-- /-- /-- & -- N -- 0001 -- = -- 537 -- & -- N -- 0552 -- = -- nine -- & -- N -- 0553 -- = -- 000011 -- " -- TARGET -- = -- "tjitemdrw" -- > -- drawing 9 -- (-- b --) -- drawing 9 -- (-- a --) -- C-C -- ' -- it can set -- a type section -- a Fig. -- be shown . The description on the configuration of this example is that is an insulating material containing a black pigment and it formed the matrix-like light-shielding film 23 (black matrix) on the opposite substrate 9 at color filter 12a and this layer. The light-shielding film 23 which consists of an insulating material does not have the effect affect the electric field E impressed between the pixel electrode 3 and the common electrode 4, could cover the poor orientation field (domain) by the electric field between the common electrode 4 and the scan electrodes 1 and 17 between the pixel electrode 3 and the scan electrodes 1 and 17, and was able to raise contrast further.

[0067] Moreover, since it formed so that an amorphous silicon 6 top as well as an example 2 might be covered, there is also no increment in the leakage current by light, and the good display property was able to be acquired. In this example, although the black pigment is used, a color is sufficient. In addition, even if not black, the

permeability of the light should just be made sufficiently low.

[0068] Moreover, since an electrode did not exist on a signal electrode 2 and 18, the capacity between signal-electrode-screening electrodes was able to mitigate from the example 2, the load of the video-signal drive circuit 20 was able to become light, and the chip size of Drive LSI could be made small, and power consumption was also able to be reduced by the unloading of a signal electrode.

[0069] As mentioned above, in this example, effectiveness equivalent to examples 1 and 2 was acquired, and the active matrix liquid crystal display of a low power was able to be further obtained by high contrast.

[0070] [Example 4] The configuration of this example is the same as that of an example 1, if the following requirements are removed.

[0071] A type section Fig. [in / for the ** type top view of the pixel of the liquid crystal display panel of this example / D-D' of drawing 10 (a)] is shown in drawing 10 (a) again at drawing 10 (b). In this example, in a 1-pixel configuration, two screening electrodes 5a and 5b were formed on the opposite substrate 9 so that signal electrodes 2a and 18a might be adjoined, and pixel electrode 3a has been arranged between screening-electrode 4a and screening-electrode 40a.

[0072] Thereby, termination of the electric field E from signal electrodes 2a and 18a is carried out to screening electrodes 5a and 5b, and a signal electrode and the pixel inter-electrode parasitic capacitance Cds are reduced sharply. Moreover, since pixel electrode 3a had arranged in the location (center section between signal-electrode 2a and signal-electrode 18a) which the distance with signal electrodes 2a and 18a left most, the capacity between signal electrodes 2a and 18a and pixel electrode 3a was further mitigable. Even if the description of this example does not constitute a common electrode, it operates the direction of a major axis of a liquid crystal molecule by the electric field between screening electrodes 5a and 5b and pixel electrode 3a, maintaining parallel mostly with a substrate side, and is in the point that the amount of transparency of light is controllable.

[0073] Moreover, the drive structure of a system of the liquid crystal display of this example is shown in drawing 11 . In this example, since screening electrodes 5a and 5b serve as a common electrode, common electrode voltage is unnecessary.

[0074] Although pixel electrode 3a is arranged in the center of signal-electrode 2a and signal-electrode 18a and the pixel is divided into two in this example, a pixel electrode may be prepared two or more [more], and more than quadrisection of it may be done. In addition, by the method which makes a common electrode use also [screening electrode] like this example, the number of partitions of a pixel becomes comparatively by 2n (n is the natural number).

[0075] Moreover, in this example, the area on the pixel flat surface which the common electrode occupied could be used for the screening electrode, by using opening further a screening electrode and pixel inter-electrode, it was able to become a high numerical

aperture, the power consumption of high brightness or a back light could be reduced, and the liquid crystal display of a low power was able to be obtained.

[0076] As mentioned above, in this example, by making a screening electrode serve as a common electrode, effectiveness equivalent to an example 1 was acquired and high brightness or the active matrix liquid crystal display of a low power was able to be obtained further.

[0077] [Example 5] The configuration of this example is the same as that of an example 4, if the following requirements are removed.

[0078] A type section Fig. [in / for the ** type top view of the pixel of the liquid crystal display panel of this example / F-F' of drawing 12 (a)] is shown in drawing 12 (a) again at drawing 12 (b). The description on the configuration of this example formed horizontally screening-electrode 5a, signal-electrode 2a, and screening-electrode 5b and signal-electrode 18a in piles.

[0079] By this, even if it does not prepare a protection-from-light layer, there is no excessive optical leakage between a screening electrode and a signal electrode, and high contrast was able to be acquired. Furthermore, the distance between pixel electrode 3a, screening-electrode 5a, and 5b became long, the area (numerical aperture) of the light transmission section between pixel electrode 3a, screening-electrode 5a, and 5b increased, and permeability improved.

[0080] As mentioned above, in this example, effectiveness equivalent to an example 4 was acquired and high brightness or the active matrix liquid crystal display of a low power was able to be further obtained by high contrast.

[0081] [Example 6] The configuration of this example is the same as that of an example 4, if the following requirements are removed.

[0082] A type section Fig. [in / for the ** type top view of the pixel of the liquid crystal display panel of this example / G-G' of drawing 13 (a)] is shown in drawing 13 (a) again at drawing 13 (b). The description on the configuration of this example is that is an insulating material containing a black pigment and it formed the matrix-like light-shielding film 23 (black matrix) on the opposite substrate 9 at color filter 12a and this layer. The light-shielding film 23 which consists of an insulating material does not have the effect affect the electric field E impressed between the pixel electrode 3 and screening electrodes 5a and 5b, could cover the poor orientation field (domain) by the electric field between screening electrodes 5a and 5b and the scan electrodes 1 and 17 between the pixel electrode 3, the scan electrode 1, and 17, and was able to raise contrast further.

[0083] Moreover, since it formed so that an amorphous silicon 6 top might also be covered, there is also no increment in the leakage current by light, and the good display property was able to be acquired. Moreover, a gap of the alignment of substrates 8 and 9 is related horizontally, and satisfactory, even if a light-shielding film 23 shifts among screening electrodes 5a and 5b, a numerical aperture does not decrease.

[0084] In addition, in this example, although the black pigment is used, a color is sufficient. In addition, even if not black, the permeability of the light should just be made sufficiently low.

[0085] As mentioned above, in this example, effectiveness equivalent to an example 4 was acquired and the active matrix liquid crystal display high-definition by high contrast was able to be obtained further.

[0086] [Example 7] The configuration of this example is the same as that of an example 1, if the following requirements are removed.

[0087] A type section Fig. [in / for the ** type top view of the pixel of the liquid crystal display panel of this example / H-H' of drawing 14 (a)] is shown in drawing 14 (a) again at drawing 14 (b). The description on the configuration of this example is in the point in which the screening electrode 5 was formed on the protective coat 11 of the TFT substrate 8. Therefore, on the opposite substrate 9, the conductive matter does not exist at all. Therefore, even if a conductive foreign matter mixes into a production process, there is no possibility of the inter-electrode contact through the opposite substrate 9, the percent defective by it is controlled by zero and the tolerance of air cleanliness classes, such as formation of the orientation film, rubbing, and a liquid crystal enclosure process, can attain simplification of breadth and production process management.

[0088] Electric connection of the TFT substrate 8 for supplying potential to a screening electrode 5 and the opposite substrate 9 also becomes unnecessary.

[0089] As mentioned above, in this example, effectiveness equivalent to an example 1 was acquired and the manufacture yield was able to be improved further.

[0090] Moreover, although this example was described based on the example 1, it is possible also in examples 2, 3, 4, 5, and 6 to constitute a screening electrode on the TFT substrate 8 like this example, and effectiveness equivalent to this example is acquired.

[0091] [Example 8] The configuration of this example is the same as that of an example 4, if the following requirements are removed.

[0092] A type section Fig. [in / for the ** type top view of the pixel of the liquid crystal display panel of this example / I-I' of drawing 15 (a)] is shown in drawing 15 (a) again at drawing 15 (b). The description on the configuration of this example formed screening electrodes 5a and 5b in this layer at the same process with signal electrodes 2a and 18a and this ingredient. electric connection of common electrode 4b and screening-electrode 5b should put on a through hole 42 to gate dielectric film 11 -- the wiring 41 formed at the same process was used for this layer with the scan electrodes 1 and 17 and this ingredient.

[0093] Since it is not necessary to prepare a screening electrode at another process and the conductive matter does not exist at all on the opposite substrate 9 like an example 7 further by this, there is no possibility of the inter-electrode contact through the opposite substrate 9. Therefore, the percent defective by it is controlled by zero and the tolerance

of air cleanliness classes, such as formation of the orientation film, rubbing, and a liquid crystal enclosure process, can attain simplification of breadth and production process management.

[0094] The reinforcement of electric field E changes with the distance of the pixel electrode 3 and screening-electrode 5a. Therefore, the variation in the distance between a pixel electrode and a screening electrode induces the variation in brightness, and poses a problem. Therefore, a high alignment precision of a pixel electrode and a common electrode is required. As for alignment precision, by the method which sticks two substrates which equipped each with the electrode, two to 3 times get worse than the alignment precision of a photo mask. Since the pixel electrode 3 and screening electrodes 5a and 5b are formed in this layer at the same process with this ingredient in this example, there is also no problem of the above-mentioned alignment precision.

[0095] As mentioned above, in this example, effectiveness equivalent to an example 4 was acquired and the high throughput and the active matrix liquid crystal display of the high yield were able to be obtained further.

[0096] Moreover, although this example was described based on the example 4, it is possible also in examples 1, 3, and 6 to form a screening electrode in this layer at the same process with a signal electrode and this ingredient like this example, and effectiveness equivalent to this example is acquired.

[0097] [Example 9] The configuration of this example is the same as that of an example 4, if the following requirements are removed.

[0098] A type section Fig. [in / for the ** type top view of the pixel of the liquid crystal display panel of ********** / J-J' of drawing 16 (a)] is shown in drawing 16 (a) again at drawing 16 (b). The description on the configuration of this example forms a screening electrode 5 in this layer at the same process with the scan electrodes 1 and 17 and this ingredient, pulls out an electrode horizontally, and is that it made common connection with the common electrode of other lines. A longitudinal direction controls a liquid crystal molecule by the electric field E between the heights projected to the perpendicular direction of the pixel electrode 3 which is perpendicularly, and a screening electrode 5. Thereby, it is not necessary to form a screening electrode 5 at another process like an example 8.

[0099] Furthermore, since the conductive matter does not exist at all on the opposite substrate 9 like an example 2, there is no possibility of the inter-electrode contact through the opposite substrate 9, and the percent defective based on it is controlled by zero. Therefore, simplification of breadth and production process management was able to do tolerance of air cleanliness classes, such as formation of the orientation film, rubbing, and a liquid crystal enclosure process.

[0100] Furthermore, it is not necessary to prepare a through hole like an example 8, and a common inter-electrode faulty connection also dies. Moreover, since the pixel electrode 3 and the screening electrode 5 are formed in the same substrate in this

example, the alignment precision of the pixel electrode 3 and a screening electrode 5 is also high.

[0101] Moreover, the projection projected to the perpendicular direction of a screening electrode 5 may be horizontally formed in piles with signal electrodes 2a and 18a. Even if this does not prepare a protection-from-light layer like an example 5, there is no excessive optical leakage between a signal electrode and a screening electrode, and high contrast can be acquired. Furthermore, the distance during the projection of the pixel electrode 3 and the common electrode 4 becomes long, the area (numerical aperture) of the light transmission section during the projection of the pixel electrode 3 and a screening electrode 5 increases, and permeability improves. Moreover, in this example, although connection of a screening electrode was made like drawing 16 , especially a connecting location is not restricted.

[0102] As mentioned above, in this example, effectiveness equivalent to an example 4 was acquired and the high throughput and the active matrix liquid crystal display of the high yield were able to be obtained further.

[0103] Moreover, although this example was described based on the example 4, it is possible also in examples 1, 2, 3, 5, and 6 to form a screening electrode in this layer at the same process with a scan electrode and this ingredient like this example, and effectiveness equivalent to this example is acquired.

[0104]

[Effect of the Invention] According to this invention, a pixel electrode does not need to be transparent, and since the usual metal electrode can be used, the active matrix liquid crystal display which can be mass-produced by the high yield is obtained.

[0105] Moreover, a viewing-angle property is good and an active matrix liquid crystal display with an easy multi-tone display is obtained.

[0106] By having formed the screening electrode especially, the parasitic capacitance between a signal electrode and a pixel electrode is mitigable, by high contrast, the active matrix liquid crystal display of high definition without a cross talk is obtained, and coexistence with the two above-mentioned effectiveness is obtained. Furthermore, when a screening electrode serves as a common electrode, the number of production processes is reduced.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is drawing showing the outline of an operation of this invention.

[Drawing 2] It is the mimetic diagram showing the configuration of the picture element part of an example 1.

[Drawing 3] example 1- it is the mimetic diagram showing the drive system configuration of 3 and 7.

[Drawing 4] It is drawing showing the viewing-angle dependency of the liquid crystal display of this invention.

[Drawing 5] It is drawing showing the viewing-angle dependency of the conventional liquid crystal display.

[Drawing 6] It is drawing showing change of the signal-level-brightness property accompanying change of the signal-electrode electrical potential difference of the liquid crystal display of this invention.

[Drawing 7] It is drawing showing change of the signal-level-brightness property accompanying change of the signal-electrode electrical potential difference of the conventional liquid crystal display.

[Drawing 8] It is the mimetic diagram showing the configuration of the picture element part of an example 2.

[Drawing 9] It is the mimetic diagram showing the configuration of the picture element part of an example 3.

[Drawing 10] It is the mimetic diagram showing the configuration of the picture element part of an example 4.

[Drawing 11] It is the mimetic diagram showing examples 4-6 and the drive system configuration of 8-9.

[Drawing 12] It is the mimetic diagram showing the configuration of the picture element part of an example 5.

[Drawing 13] It is the mimetic diagram showing the configuration of the picture element part of an example 6.

[Drawing 14] It is the mimetic diagram showing the configuration of the picture element part of an example 7.

[Drawing 15] It is the mimetic diagram showing the configuration of the picture element part of an example 8.

[Drawing 16] It is the mimetic diagram showing the configuration of the picture element part of an example 9.

[Description of Notations]

1 17 [-- Common electrode,] -- 2 A scan electrode, 18 -- A signal electrode, 3 -- A pixel electrode, 4 5 -- A screening electrode, 6 -- An amorphous silicon, 7 -- n+ mold amorphous silicon, 8 9 [-- Color filter,] -- A substrate, 10 -- Gate dielectric film, 11 -- A protective coat, 12 13 [-- Vertical-scanning circuit,] -- 14 The flattening film, 15 -- The orientation control film, 16 -- A liquid crystal layer, 19 20 [-- A light-shielding film, 25 / -- 26 A liquid crystal molecule, 27 / -- A deflecting plate, 28 / -- The direction of orientation, 29 / -- A deviation transparency shaft, 41 / -- Wiring, 42 / -- Through hole.] -- A video-signal drive circuit, 21 -- A power source and a control circuit, 22 -- A liquid crystal display panel, 23